MACROECONOMIC DETERMINANTS, GOVERNANCE AND TECHNOLOGICAL PROGRESS IN NIGERIA

(1996-2012)

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ABSTRACT

This paper investigates the level of technological progress (total factor productivity). And explores the impacts which macroeconomic determinants (consistent with the endogenous growth theory), and governance performance in Nigeria has on the estimated level of technological progress in the economy.

The Solow residual is used to estimate technological progress in the economy. And the OLS method to estimate the relationship which macroeconomic determinants and governance performance has on technological progress over the period of 1996 to 2012.

It was observed that foreign direct investments, increasing expenditure on education and trade openness of the economy are very important for technological catch-up. Whilst the level of available credit to private sector and poor governance performance in Nigeria is reflected in their negative relationship with technological progress, education and governance was observed to be the most significant in impacting technological progress.

Hence, these recommendations are drawn for consideration of policy makers: that measures should be taken to improve the quality of governance in the country and the effectiveness of public institutions. Progressive and liberal trade policies should be incorporated to allow for market competition and help consolidate the technological gap by fostering foreign technology diffusion and adaptation. Policies favorable towards foreign capital inflow should be implemented and that such capital inflow should be incentivized into diverse sectors of the economy to enable balanced technological progress across the various sectors. The Nigerian government should adopt policies which increases the availability of quality education to Nigeria's large and increasing populace. Implementation of such would be of great significance in accumulating human capital in the economy and cultivating Nigeria's huge labor force towards attracting multinational corporations, production outsource into the Nigerian economy from advanced economies as this would foster much needed industrialization and ultimately technological progress and economic development.

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CHAPTER ONE

1.0 BACKGROUND OF THE STUDY

Technological progress is fundamental in a country's development and economic growth. It can be explained as better ways for production and using scarce resources more efficiently. Technological progress reflects growth of human knowledge in the use of capital, enhancing labour productivity and a basis for the rise in real income of households and individuals. When technological progress is made, development is also being achieved.

Innovations and continual pushing of the boundaries of technical knowledge is a principal trait that distinguishes a country as advanced or developed. In less developed countries (LDC's), realizing technological progress is initially ascribed as technological catch-up.

The importance of technological progress in an economy's development cannot be overstated. In LDC's, the capacity to realise progress in technology is the major cause for industrialization. This leads to attraction of Foreign Direct Investment, increasing economic and social opportunities, and overall improved welfare due to explicit externalities of technological progress. However, inability to achieve meaningful technological progress in an economy results in technological backwardness, economic stagnation and underdevelopment which majorly characterise developing countries.

In Nigeria, technological backwardness of the economy is reflected by low productivity across the various sectors. Also, perpetual dependence on imported capital goods such as electronic and mechanical machines or equipment due to inability to domestically produce them. The failure of the economy so far to evolve from its chronic primary goods production or factor driven state, further stresses technological backwardness of the State.

The function of the government in productively directing the social and economic affairs is most important in a nation's development and course of history. Unfortunately, persistent corruption and bad governance in the Nigerian State is prevalent and as well documented (by both media and scholars). However, its relation with the level and progress of technological capability of the economy should be considered of utmost bearing and significance.

It is pertinent to state here that bad governance in Nigeria being a major cause for the technological backwardness of the economy is conjectural and therefore demands inquiring study of the conception for comprehension, as well as to posit possible recommendations that will aid attainment of meaningful technological progress towards economic development.

1.1 STATEMENT OF THE PROBLEM

A major issue facing the world economies is the extent to which technological progress is both enabling developing countries to facilitate economic development and accumulation of technological capabilities whilst also increasing the gap between advanced nations and less developed countries who are slow on the uptake of modern production methods, new knowledge and even conventional technologies due to inherent economic deficiencies.

As a result of increasing globalization and international trade in the world, technological disparity amongst nations is made even more glaring in the existence of a dual economy in LDC's. Such that the economy is made up of

a) A traditional agrarian economy which employs a vast majority of the population, coexisting alongside
b) A modern capital-intensive enclave often affiliates of foreign multi-national companies which utilises advanced technology mostly for mineral extraction. Also, increasing imports of hi-tech consumer products benefiting only a small elite class.

The result of this disparate arrangement is an economy unable to generate innovations, extremely poor performance of the manufacturing sector as revenue from manufactured exports is virtually insignificant in Gross domestic product and also technologically dependent on advanced foreign economies. This further constitutes a conspicuous lack of blue collar employment contributing to the wide financial and social disparity between the poor (majority of the population) and the rich.

Whilst some less developed countries[the Newly Industrialized Economies: NIE's] made significant strides in technological progress and successfully accomplished meaningful economic development, technological backwardness however remains a constant feature of some other countries of the less developed world.

In the 1960s through to the 1980s, countries of Latin America, South East Asia and Africa were altogether facing the problem of technological backwardness and technical ignorance. The beginning of the 21st century has however seen it become more or less a phenomenon majorly of the African states. Diminishing agricultural production, stagnating manufacturing, ever increasing imports and continuous insecurity are the traits synonymous with Africa. In addition, prevalent bureaucratic corruption, institutional ineptitude as well as outright failure of the government is common in this region.

Although there are several macro-economic factors determining the technological backwardness and at the same time underdevelopment of a country, however for LDC's such as African states, bad governance has been a most fundamental cause. This is not to say that bad governance is particular only to LDC's, bad governance is a phenomenon that affects even the most advanced nations but its debilitating effects is felt the most by the LDC' due to their economic vulnerability.

Given that bad governance stems from leadership, the misfortune and poverty which Africa suffers today is not surprising with its history of recurring corrupt and selfish heads of the various African states. Foreign media and studies have reported that African leaders are self-aggrandizers and self-perpetuators who subvert every key institution of government to serve their personal gain and neglect the public welfare. It has also been reported that African leaders extract billions of dollars into offshore account every year from their already financially strapped countries. International agencies and economic experts agree that corruption in Africa is a manifestation of its bad governance, its undemocratic leaderships, and its institutional incompetence post-independence.

Nigeria's history from the first republic until date has been replete and inter-fused with bad governance. From corrupt military dictatorial rule which prevailed for about 2/3rd of the country's years of independence during which an astounding six successful coup attempts were pulled to this present immoral democratic system . Since the eventual dawn of democracy, elections have been virtually undemocratic, authoritarianism tendencies of the predominant political party are revealed and also widespread corruption and unashamed rent seeking by purportedly elected public officials across

the various tiers of government. Due to crude-oil money and other state resources, democracy ironically only seem to exacerbate the resource curse as it offers a convenient opportunity for greedy individuals to occupy government and amass personal wealth thereby turning elections into a free-for-all. These features are what perpetuate underdevelopment and culminates in an unstable economic environment which hinders technological progress in the Nigerian economy.

1.2 RESEARCH QUESTIONS

- How do we measure technological progress and good governance in Nigeria?
- What effect does economic and governance performance have on technological progress in Nigeria's economy?
- How can the economy realise meaningful technological progress and economic development?

1.3 OBJECTIVES OF THE STUDY

The objectives of this study work includes

- To examine the effect of macroeconomic determinants and governance performance on technological progress in Nigeria
- To recommend appropriate measures for technological catch-up, industrial and economic development.

1.4 JUSTIFICATION FOR THE STUDY

Despite the obvious significance of technological progress which reflects in development of any economy, technological progress in the Nigerian economy remains grossly understudied.

This study shall serve as an insight on the effect major which economic determinants and governance performance has on the level technological progress and the development of the economy in general. Therefore, ways on how technological progress can be achieved from its current state of backwardness, how government's performance can be improved and macroeconomic policies favourable towards technological progress shall be recommended.

This study will therefore be useful for government and policy makers towards formulating policies and making decisions that will enable technological progress and also those that view the developing economy of Nigeria favourably.

The type of data that will be used, in the course of our study, will be secondary data due to its readiness and availability. Hence it will be acquired from the World Bank data bank and CBN statistical bulletin.

1.5 RESEARCH HYPOTHESIS

- H_0: There is no significant relationship between economic performance, good governance and technological progress
- H_1: There is a significant relationship between economic performance, good governance and technological progress

1.6 SCOPE OF THE STUDY

This study focuses on the effects which macroeconomic determinants and governance performance has on the level of technological progress in Nigeria. Spanning the period of 17 years from 1996 to 2012

1.7 LIMITATIONS OF THE STUDY

The major limitation to our study was the lack of adequate data, to extend the scope of study, from a period of 17 years (1996-2012), to a larger scope of study.

CHAPTER TWO

LITERATURE REVIEW

2.0 INTRODUCTION

This study was not absolutely based on the ideas of the researcher in question alone but it also includes an in-depth and careful combination of ideas and opinions of different writers that are corroborative in nature to the study. Therefore this chapter will present the conceptual framework of technological progress and governance.

2.1 THEORETICAL BACKGROUND: TECHNOLOGICAL PROGRESS

Technological progress is from the word "technology". Technology is defined by the Encyclopædia Britannica as "*the application of scientific knowledge to the practical aims of human life or, as it is sometimes phrased, to the change and manipulation of the human environment*."

Technological progress, synonymous with Technical change; technological change; and technical progress can therefore simply be explained as new and better ways of doing things and of manipulating the environment. In an economic context, technological progress means better techniques for using the factors of production or scarce resources. Advancement in technology, resulting in better methods for production. " *change in the amount of output produced from the same amount of inputs.*"

Standard neo classical approach assumes two input factors in production: labor and capital which are scarce and limited. Given a specified or limited cost of production, a producer uses a combination of labor and capital which yields the most possible output from the limited available resources. A graphical representation of this is called an isoquant. On an isoquant, there are only so many points or combinations of capital and labor which maximizes the input factors and attains equilibrium. However, a technical change can lead to rise in output even without an increase in inputs essentially causing an outward shift of the isoquant curve.

Technical progress causes a direct increase in output in production function and also increasing the steady state capital stock. It has been the major force behind economic growth over time. Robert Solow's (1957) estimates that 87.5% of economic growth stems from technological progress*:* "*improvements in efficiency and effectiveness of industry*". Technological progress can be in that of a firm, or an entire nation. Essentially, it is being able to enhance productivity.

The concept of technological progress cannot be conversed properly without allusion at what productivity is. Steindel and Stiroh (2001) comprehensively explain productivity as "*real output per unit of all inputs which reflects the overall efficiency with which inputs are transformed into outputs. Productivity also reflects the impact of a host of other factors like economies of scale, any unaccounted inputs, resource reallocations, other factors and is most often associated with technology*".

Based on economic growth accounting literature, an economy's production function is explained by the inputs of labor and capital and any residual not explained by these inputs is considered as total factor productivity growth, which also measures technological progress broadly (Hayani, 2001). Krugman (1999) states that "*Productivity isn't everything, but in the long run it is almost everything. . . .A country's ability to improve its standard of living over time depends on its ability to raise its output per worker*."Hence, we can understand that technological progress is an increase in a country's productivity which is not directly explained by labor and capital.

2.1.1 STAGES OF TECHNOLOGICAL PROGRESS

Technological progress is a process involving 3 stages

a) **Invention:** invention is the creation of something new, formulation and application of ideas which physically had not been in existence. To be called an invention, an idea needs to be proven as workable. To be patentable, "*an invention must be novel, have utility, and be non-obvious to someone skilled in the art*"(World Intellectual Property Organization). A count of patents and patents rights application in a country reflects its extent of technological activity and also its capacity to exploit knowledge and translate it into potential economic gains.(*It is worthy to note that Sub Saharan Africa has had the lowest of such activities in contemporary history*). Some model examples of inventions of the 21st century are the birth control patch, Nano technology, artificial intelligence, robotics and automation.

b) **Innovation**: Innovation is the application of new solutions that meet new requirements, inarticulate needs, or existing market needs. This is accomplished through more effective products, processes, services, technologies, or ideas that are readily available to markets, governments and society. "*An innovation is something original, new, and important - in whatever field - that breaks in to (or obtains a foothold in) a market or society*"(Wikipedia). Innovation differs from invention in that innovation refers to the use of a better and, as a result, novel idea or method, whereas invention refers more directly to the creation of the idea or method itself. To be called an innovation, an idea must be replicable at an economical cost and must satisfy a specific need. Some great innovations of the 21st century are the Wikipedia, Google, hybrid cars, i phone, retinal implant(for the blind), thin-film solar panels, the i pad, 3d printing, cloud data storage, e-cigarettes and the aids vaccine.

c) **Diffusion**: diffusion is the integration and spread of a technology through a society or industry. Inventions and innovations must be successfully diffused into society and industry in order for its economic potential to be realized. Some inventions and innovations which have been successfully in diffused into society and put to economic use are Google, birth control patch, solar energy, 3d-printing, hybrid cars, cloud data storage, wireless technology and credit cards(ATM's).

Globalization and liberal trade have enabled developing countries to utilize and adopt innovations of advanced countries thereby consolidating the technology gap and disparity. But the gap remains large and increasing. Technological Progress in developing countries depends mainly on their capacity to absorb and adapt foreign technologies – rather than innovating themselves.

2.1.2 CLASSIFICATION OF TECHNOLOGICAL PROGRESS

Technological progress can be broadly classified into three

a) Labor savings technological progress: Also called the Harrod-neutral technical progress. A labor saving technological progress enables producers to produce the same amount with relatively less labor input. It is improvements in technology that increase the efficiency of labor. Roy Forbes Harrod explains it as technical progress which allows producers to make more with less. Generally results in lower expenses and, on a large scale, it can spur economic growth. However, it can also cause unemployment by making employees with certain skills unnecessary.

According to Hicksian criterion, labour-saving technical progress may be defined as that kind of technological improvement and change in the process of production which increases the marginal productivity of labor relatively to that of capital.

b) Capital savings technological progress: A capital saving technological progress enables producers to produce the same amount with relatively less capital input. It refers to that new process which tends to increase the marginal productivity of capital relatively to that of labor.
c) Neutral technological progress: A neutral technological progress allows producers to produce more with same capital labor ratio (do not save relatively more of either input). John Hicks 1932 in the theory of wages posited that the effect of neutral innovation is to raise the marginal productivity of both the factors - labor and capital - in the same proportion. Thus, neutral technical progress keeps the relationship between labor and capital unaffected but increases overall productivity.

Technological progress can also be grouped into two parts:

a) Embodied Technological Progress: Improved technology which is exploited by investing in new equipment. New technical changes made are embodied in the equipment.
b) Disembodied Technological Progress: Improved technology which allows increase in the output produced from given inputs without investing in new equipment.

2.2 THEORETICAL ISSUES ON GOVERNANCE

To understand the concept of governance, it is important that we make distinct reference to the word "government"; from which governance is taken. "*Government, the political system by which a country or community is administered and regulated*."(Encyclopædia Britannica). Political theory uses the term 'government' to refer to the formal institutions of the State and their monopoly of legitimate coercive power. Stoker (1998) explicated that "*government is characterized by its ability to make decisions and its capacity to enforce them. Moreover, government is understood to refer to the formal and institutional processes which operate at the level of the nation state to maintain public order and facilitate collective action.*"

In theory, there are numerous forms of government. In the affairs of States of the world today, Democracy, Monarchy and Communist states are the three principal systems of government. These forms of government are sometimes intertwined to varying degrees in some countries while some other countries are exclusive to just one system. There is much debate over which form of government is better for the State, however, there are economists who argue that the performance of government is much more important than the system of government as economic development and failure has been witnessed in all these systems of government.

Lately, in the discourse of politics and economies, the term; *government* has become somewhat unattractive. Instead, *governance* is more referred to. The simple reason for this is that; the government is what is (and discontent with it is omniscient), governance is with the notion of what it ought to be. This transition to governance in economic study is majorly concerning decentralization and common ideological shift towards liberalism. Decentralization generally has to do with changing, dispersing and usually diminishing the role of the state. That is, decision making and implementation capacities which results in a more fragmented public sector.

The decentralization which took place in many western European countries in the late 1940's and early 1950 was as a result of the Marshall Plan 1948. The Plan was a "*U.S-sponsored program designed to rehabilitate the economies of 17 western and southern European countries in order to create stable conditions in which democratic institutions could survive*."(Encyclopædia Britannica). It was very successful in generating reconstruction of Western Europe. Economic scholars and analysts began to advocate the Keynesian ideas which was the basis of this Plan and recommended such for less developed countries. "*In the perspective of these economists, development in the emerging states of what has since become known as the Third World would be best achieved through transfers of capital and technical expertise*" Hyden and Court (2002).

Initial scholars of economic development implied development to be a transition from a traditional society to a modern society. The objective was that, the ideas, institutions and techniques which worked so well in modernizing the western world were to be replicated in the Third World. "*Government and other public institutions were identified as responsible for ensuring effective implementation. Private and voluntary sector organizations were ignored*" Hyden and Court (2002). Development, then, up till the late 1960's was thought to be a top-down process by the government and public institutions for the people.

In the 1960's when analysts and policy makers began to realize that a sole focus on development in the context of national plans was very much inadequate as their initial assumptions of a trickledown effect from elite to poor and delusions of singularly proficient government proved to be futile. Analysts began to advocate development for the people which focused on Human capital. That is, adult education and universal primary education in these less developed states. The assumption being that these measures were integral parts of a poverty-oriented approach to development.

Towards the late 1970's when it became seemingly clear that governments most especially in sub-Saharan Africa lacked the technical capacity and bureaucratic competence to solely administer the arduous task of development. The role of the state in bringing about much desired modernization of the Third World came into question. The World Bank, charged by it governors, took the lead on this imperative issue and with much priority to sub-Saharan Africa, produced a major policy report outlining necessary economic reforms to achieve development. "*This report was to serve as the principal guide for structural adjustment in Africa in the 1980s, although the strategy was also applied in other regions of the world*" (Hyden and Court 2002). The Structural Adjustment plans subsumed major economic and governmental interests of the state,

with more responsibilities delegated to the market and the people. The implementations of these plans were a pre-requisite for third world countries to receive much needed financial assistance from the World Bank.

The effectuation of these structural adjustment plans as we all now know was not cut out for these sub-Saharan countries at the time or at their immature economy stage and has rightly so been heavily criticized by most economic scholars and analysts. However, its underlying ideas on what governance ought to be has permeated introspective on the political economy and remained.

The term "governance" was first made of wide recognition in issues of economies in the 1989 World Bank study "Sub-Saharan Africa - from crisis to Sustainable Growth". The study was as a result of worsening economic performance of the region despite the implementation of the World Bank prescribed structural adjustment programs (SAP's). In the study, the term was first used to describe the need for institutional reform and a better and more efficient public sector in sub-Saharan countries.

Kemp et al (2005) elucidated that *"...governance is a concept that was first widely explored and embraced in the late 1980's...it was attractive because it encompassed a broad set of factors that were increasingly important and insufficiently recognized in conventional thinking...the notion of governance highlighted the increasingly important role of formal and informal arrangements in the political economy..."*

The concept of governance is widely debated amongst scholars, policy makers and international organizations. Governance has been defined and used in many ways in different contexts. Although consensus upon a single definition of the concept is yet to be agreed upon, however, the main objective has always been for the government to fulfil good governance.

Governance was defined in the World Bank (1989) "Sub-Saharan Africa - from crisis to Sustainable Growth" as "*the exercise of political power to manage a nation's affairs*". As a foreword in the study, Barber Conable (former World Bank president) described good governance as "*public service that is efficient, a judicial system that is reliable, and an administration that is accountable to its public*".

The idea of governance was further developed by the World Bank in its 1992 publication "Governance and Development". Here, governance was defined as "*the manner in which political power is exercised in the management of a country's economic and social resources for development*". The World Bank in the publication specified that its interest in governance derives from its concern for the sustainability of the projects it helps finance. Good governance was described as predictable, open and enlightened policy, together with a bureaucracy infused with a professional tenet and an executive arm of government accountable for its actions.

Although the World Bank is the most prominent proponent of the concept, other international agencies like her have also made similar indoctrinations on governance.

The Asian Development Bank (AsDB) in its 1995 policy paper "Governance: Sound Development" defined good governance as "*the manner in which power is exercised in the management of a country's economic and social resources for development*". The AsDB further explained that governance had at least two dimensions; political (e.g., democracy, human rights); and economic (e.g., efficient management of public resources).

Also, the United Nations Development Programme (UNDP) in its 1997 policy document entitled "Governance for Sustainable Human Development" states that "*governance can be seen as the exercise of economic, political and administrative authority to manage a country's affairs at all levels*". The document explained that governance has three dimensions: economic, political and administrative. Economic governance includes the decision-making processes that affect a country's economic activities and its relationships with other economies. Political governance is the process of decision making to formulate policy. Administrative governance is the system of policy implementation. Encompassing all three, good governance defines the processes and structures that guide political and socio-economic relationships.

The conceptions of governance by these international bodies are usually resulting in criteria which deem the quality of governance in a State. The criteria cited by these bodies are remarkably similar; however, the World Governance Indicators (WGI) project of the World Bank is the most generally used.

Worldwide Governance Indicators defines governance as "*the traditions and institutions by which authority in a country is exercised. This includes (a) the process by which governments are selected, monitored and replaced; (b) the capacity of the government to effectively formulate and implement sound policies; and (c) the respect of citizens and the state for the institutions that govern economic and social interactions among them*."

The WGI measures how good, governance is or the performances of government according to these criteria in countries all over the world. The Bank constructs two measures of governance corresponding to each of these three circumstances in which authority in a country is exercised. This results in a total of six dimensions of governance.

a) The process by which governments are selected, monitored, and replaced:

i. Voice and Accountability (VA) – capturing perceptions of the extent to which a country's citizens are able to participate in selecting their government, as well as freedom of expression, freedom of association, and a free media.

ii. Political Stability and Absence of Violence/Terrorism (PV) – capturing perceptions of the likelihood that the government will be destabilized or overthrown by unconstitutional or violent means, including politically-motivated violence and terrorism.

b) The capacity of the government to effectively formulate and implement sound policies:

iii. Government Effectiveness (GE) – capturing perceptions of the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies.

iv. Regulatory Quality (RQ) – capturing perceptions of the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development.

c) The respect of citizens and the state for the institutions that govern economic and social interactions among them:

v. Rule of Law (RL) – capturing perceptions of the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence.

vi. Control of Corruption (CC) – capturing perceptions of the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as "capture" of the state by elites and private interests. World Governance Indicators (WGI)

Minogue, Polidano and Hulme (1998) argue that modern form of governing is about more than just efficiency, that governing is about accountability between the state and its citizens. It is about *"...people who are treated not merely as consumers or customers (as in the new public management approach) but as citizens, who have the right to hold their governments to account for the actions they take, or fail to take*"

Fukuyama(2013) defines governance as "*a government's ability to make and enforce rules, and to deliver services, regardless of whether that government is democratic or not*." Fukuyama further noted that he was keener on government's "infrastructural" rather than "despotic" power according to Mann 1984. "*Governance is about the performance of agents in carrying out the wishes of principals, and not about the goals that principals set. The government is an organization which can do its functions better or worse; governance is thus about execution, or what has traditionally fallen within the domain of public administration, as opposed to politics. An authoritarian regime can be well governed, just as a democracy can be mal-administered*" (Fukuyama 2013).

The increasing recognition that politics and institutions are central to the process of economic growth and development by affecting the incentives to accumulate, innovate and adapt to contemporary change have led economists, development experts and international policy-makers to agree that good governance is of great importance and a pre-requisite to sustained increases in living standards Kaufmann et al.(2000) Knack (2003). However, their perception on the role which governance plays or should play in an economy's development appears to be conflicted.

Khan (2006) explained that the differences of view between economist regarding governance has to do first , with the types of state capacities (system of government) which appropriately constitutes the critical governance functions necessary for the acceleration of development. Secondly, the importance of governance relative to other factors at initial stages of development.

Regarding the first issue ; the types of state capacities, Khan (2006) explained that "there is an important empirical and theoretical controversy between liberal economists who constitute the mainstream consensus on good governance and statist and heterodox institutional economist who agree that governance is critical for economic development but argue that theory and evidence shows that the governance capacities required for successful development are substantially different from those identified by the good governance analysis."

Kemp et al (2005) elucidated that the usage of the concept of governance by the World bank and OECD, is in order to serve their neo-liberal agenda of reducing the role of governments in favor of market mechanisms and corporate interests OECD (1995); World Bank, (1992). Furthermore, Kemp et al noted that the presentation of governance by these agencies was as a means of promoting democratic pluralism. He noted that governance by these agencies "*overlooks the authoritative role of government as seen by its citizens*" something which is still very prominent in developed countries such as Denmark and Britain in Europe and Asian countries such as PR China.

Secondly, Glaeser et al (2004) in his study on political institutions and economic growth deduced that in many poor countries, economic growth can be attributed to policy choices made by dictators. He concluded that "*The economic success of East Asia in the post war era and of China most recently, has been a consequence of good-for-growth dictators, not of institutions constraining them*". Notwithstanding, current orthodoxy in the development community is that democracy and good governance are mutually supportive. Liberal economist in favor of mainstream good governance principles argue that the capacities of the state should be to maintain efficient markets and her functions restricted to the provision

of necessary public goods to minimize rent seeking and government failure. The relative failure of many developing countries are explained by the attempts of their states to do too much, resulting in the unleashing of unproductive rent seeking activities and the crowding out of productive market ones as claimed by Khan (2006)

2.2.1 IMPORTANCE OF GOVERNANCE

The importance of governance is all encompassing in an economy's welfare and development. The performance of a country's government is inextricably attached to the welfare of its citizens, the country's economic growth and the perception of the state on the international scene.

The pursuit of economic development and better welfare of citizens is a responsibility all governments have. Citizens entrust the State to properly manage their tax money and natural resources of their country for the benefit of all. To provide essential public services and infrastructure such as water, sanitation, power supply, transportation, access to health care etc. (or expedite the market which does). The government is charged with the national security, and protection of human rights such as education, private property and justice.

These responsibilities or duties which the government must perform are crucial to every individual and to the whole economy. Misappropriation and negligence of these duties and trust of the public is the cause of poverty, break down of law and order, macro-economic instability, discontentment of the people, chaos and can eventually lead to war e.g. Sudan, Syria, thereby making the present and future lives of the people difficult and impeding effort towards economic development.

A State's performance in indicators such as voice and accountability (VA), Political stability and Absence of Terrorism/Violence (PV), Government Effectiveness (GE), Regulatory Quality (RQ), Rule of Law (RL), and Control of Corruption (CC) is a reflection of the welfare of its people. We can infer that it’s no coincidence that States with high scores in these indicators also have highest citizen standards of life on earth. e.g. Australia, Denmark , New Zealand, Singapore ,Canada etc. whilst poverty, insecurity and misery is the case for countries such as Somalia, Zimbabwe, Sri-Lanka, North Korea, Sudan etc. and even Nigeria with corresponding pathetic governance scores.

The quality of governance across countries all over the world has been the difference leading to the initial industrialization and continual development of some economies while other economies remain stagnant and or even deteriorating.

2.3 MACROECONOMIC DETERMINANTS AND TECHNOLOGICAL PROGRESS

Akinlo (2006) explores the effects of macroeconomic factors on total factor productivity in 34 sub-Saharan African countries. Results from his panel econometric analysis shows that some macroeconomic variables (i.e. external debt, inflation and human capital) included in the estimation have a significant impact on productivity.

Therefore, policies geared towards reducing the rate of debt accumulation, low inflation and improvement in human development will boost total factor productivity in the continent. Other macroeconomic variables such as openness and trade orientation have been investigated by Miller and Upadhyay (2000) as potential determinants of total factor productivity in a panel of some developed and developing countries. Their results revealed that a higher level of openness and outward oriented countries will experience a higher level of productivity. The level of human development is also found to have a positive and significant impact on productivity. Edwards (1998) and Gurney and Englander (1994) likewise suggest that more open economies will experience faster productivity growth. [Akanbi 2011]

2.3.1 EDUCATION AS A MACROECONOMIC DETERMINANT OF TECHNOLOGICAL PROGRESS

An important role of education – and the resultant accumulation of human capital – for a less-developed economy are to facilitate technology diffusion in order for it to catch up with developed economies. The impact of education on human capital accumulation is well-established in economic literature. [Koh and Leung 2003]

Education increases an individual's capacity, first, to innovate (i.e. to create new products and new technologies) and, second, to adapt to new technologies, thereby accelerating technological diffusion in the economy. Nelson and Phleps (1966) argues that the accumulation of human capital is inseparable from technological progress, and may occur in different ways – through learning in schools, research and innovations in laboratories and in the course of production and commerce.

In less developed countries, education contributes to the economic growth by facilitating a more rapid pace of technology diffusion in order for technological catch up with the developed countries. Heckman (2002) noted that an individual who has undergone training in a discipline (say, accountancy) would improve his performance in that discipline. An equally important indirect effect of education is to increase the flexibility of the labor force and its capacity to learn new ideas, adapt to new technologies, improve local technologies on the job, as well as to better-equip workers to undertake scientific research and innovation. [Koh and Leung 2003]

In endogenous growth literature, human capital is a central input for innovation and R&D activities. An increase in investment in education accelerates technological progress through the creative destruction of old ideas and processes.

The benefits of education in developing countries is evident, not only through the training of workers to work with more sophisticated technology, but also in developing a group of specialized labor that may be devoted to R&D and innovation activities. Nelson and Phelps (1966) noted that "education has a positive payoff only if the technology is always improving".

Koh and Leung (2003) also argue that facilitating the diffusion of knowledge and technology through education offsets the diminishing returns to physical capital.

2.3.2 FINANCIAL DEVELOPMENT AS A MACROECONOMIC DETERMINANT OF TECHNOLOGICAL PROGRESS

Broad consensus in economic literature holds that financial development promotes economic growth through increasing the level and efficiency of capital and investments Levine (2003). In contrast, empirical research in development economics establishes that economic growth is predominantly driven by productivity growth rather than, as commonly thought, by capital accumulation Solow (1957), Mankiw et al. (1992), Krugman (1993), and Hall and Jones (1999)).

Easterly and Levine (2003)) argue that Total factor productivity (TFP) growth could account for as much as 60% of countries' growth in per capita GDP. The importance of productivity as the principal source of economic growth suggests for investigations on the role of financial development in explaining the dynamics of productivity, and not just its role in explaining investment behaviour and capital accumulation.[Solomon Tadesse, 2000]

Strong banking and well-developed capital markets may promote technological advancement and productivity in a number of ways.

Firstly, adoption of technologies requires large amount of capital that could easily be mobilized in well-developed financial systems. The intimate relation between financial markets and technological progress was first emphasized by Hicks (1969) in attempt to explain the genesis of the industrial revolution. Hicks (1969) argue that an essential feature of industrial development is adoption of technologies that require large scale illiquid capital investments. Financial markets that provide risk-sharing possibilities to investors make it economically feasible to implement such technologies. For Hicks, the industrial revolution was not associated with the discovery of any particular new technology. He argues that most of the technical innovations had been made before the onset of the industrial revolution. However, their adoption and full implementation on an economical scale required the commitment of large-scale investments for a long period in an illiquid-capital form. Financial markets that provide investors with liquidity made investments in such technologies feasible. Thus, countries' technological progress and the maturity of their financial systems in mobilizing capital are directly related.

Second, well-developed capital markets and institutions encourage adoption of long-gestation productive technologies through reducing investors' liquidity risks. Bencivenga, et al. (1995), Bencivenga and Smith (1991), and Greenwood and Jovanovic (1990). Well-developed financial systems insure investors against liquidity risk, leading to the financing of longer-term and riskier, yet productive, projects. Bencivenga and Smith (1991) argue that financial intermediaries promote real growth through providing a means for reducing liquidity risk. First, banks permit risk-averse savers to hold bank deposits rather than liquid (and unproductive) assets, thereby increasing funds available forproductive capital. Second, by eliminating self-financed capital investment, banks prevent unnecessary capital liquidation by entrepreneurs due to liquidity needs.[Solomon Tadesse, 2000]

Thirdly, by providing hedging and other risk sharing possibilities, financial markets and institutions promote adoption of specialized vis-à-vis generalized, and hence risky, technologies. Saint-Paul (1992) provides a model in which financial markets interact with the technological choice of the firm in that financial markets allow riskier but more productive technologies, and the technological choice, in turn, affects the viability of financial markets. By enabling agents to hedge against risk through holding diversified portfolio, financial markets permit more division of labor in the real sector,

leading to higher productivity. Financial markets and technology are, therefore, strategically complementary in that both are instruments for risk diversification. Where capital markets provide limited and poor risk sharing services, diversification occurs through the choice of inferior technologies which are both less specialized and less productive. Typically, underdeveloped financial markets are associated with unproductive flexible technologies and less division of labor, and developed financial markets are associated with specialized and risky technology. In Greenwood and Jovanovic (1990) financial intermediaries facilitate high-yield investments and growth by pooling idiosyncratic investment risks across a large number of investors.

Lastly, because financial development encourages technological innovation primarily via making financial capital available, one would expect that those firms that rely on external finance for financing innovation – or firms for which lack of finance could be a binding constraint in realizing innovation – to benefit more from financial development.[Solomon Tadesse, 2000]

2.3.3 TRADE OPENESS AS A MACROECONOMIC DETERMINANT OF TECHNOLOGICAL PROGRESS

Trade liberalization increases competitive pressures on domestic firms, and thus creates incentives for reducing costs of production through technological progress. Harrison et al. (2006) evaluates the impact that the liberal reforms carried out by the European Union under the Single Euro Market have had in innovation intensity and finds that these policies have increased both competition, measured as a reduction in mark-ups, and innovation intensity, measured as R&D expenditures over sales, leading to productivity growth in the manufacturing sector.[Navas-Ruiz 2007]

Rivera-Batiz and Romer, (1991) and Devereux and Lapham, (1994) find that Openness to trade promotes the exchange of knowledge leading to growth, the technological knowledge spill overs. However, in these studies trade openness gives little space to competition, because of the monopolistically competitive nature of markets and the assumption that innovation is carried out by potential entrants. In Rivera-Batiz and Romer, for example, mark-ups only depend on the elasticity of substitution among varieties; moreover, openness totrade increases the market size and the number of firms in the same proportion, leaving innovation rents unchanged.

Peretto (1999) suggests an extension of Romer's (1990) model, by adding cost- reduction innovations and strategic interaction among firms. A rise in product market competition through trade openness produces higher growth by reducing the number of firms, which increases mark-ups and makes firms to innovate more. Therefore, there is a trade-off between competition and growth, since higher growth is associated with lower number of …firms and higher mark-ups. Peretto (2003) in extension shows that trade openness reduces both the global number of firms and R&D costs –due to technological spill overs and increasing incentives to innovate.[Navas-Ruiz 2007]

2.3.4 FOREIGN DIRECT INVESTMENT AS A MACROECONOMIC DETERMINANT OF TECHNOLOGICAL PROGRESS

Foreign direct investment (FDI) has been traditionally considered an important channel in the diffusion of advanced technology. Foreign direct investment (FDI) is a vital source for many less developed countries (LDCs) to obtain international capital and advanced technology. It brings positive spill over effects and stimulates technology progress in less developed countries.

In developing countries such as Nigeria, Foreign direct investments are primarily carried out by Multi-National Companies (MNCs) primarily. MNCs have obvious advantages compared to domestic firms, and possess of the most vital parts in the world economy. The contribution of FDI on technology transfer is obvious in theory. LDCs attract FDI, and then bring technology spill over effects through demonstration, imitation, reverse engineering, individual contact, diffusion of management skills. This is beneficial to shrink the gap in high-technology with developed countries and improve the technological innovation capabilities. However, the spill over effects cannot happen automatically; moreover, FDI may also bring negative spill over effects. Because of the stickiness of information von Hipple, (1994), most technology and knowledge are tacit knowledge. Only through practice can they be mastered. The process and the extent to which spill over occur were determined by both the owner of advanced technology (MNEs) and the receivers (local enterprises in the host countries) Narula and Marin, (2003). The introduction of more advanced technology and the requirement of absorptive capability in the host country were twin factors of technological spill over Borensztein et al., (1998).

2.4 ECONOMIC GROWTH ACCOUNTING: THE SOLOW RESIDUAL

Growth accounting is a procedure used in economics to measure the contribution of various factors affecting economic growth and to indirectly compute the rate of technological progress, measured as a residual, in an economy. This methodology was introduced by Robert Solow in 1957.

Growth accounting decomposes the rate of an economy's total output growth into that which is due to increases in the amount of factors of production used (i.e. capital and labor) and that which cannot be accounted for by observable changes in factor utilization.

The difference between the percentage change in output and that of input is often referred to as the Solow Residual. It is the portion of GDP growth that can't be explained by the growth in capital and labor. The unexplained part of growth in GDP is then taken to represent increases in productivity (increased efficiency of production processes leading to more output from the same amounts of inputs) or a measure of broadly defined technological progress.

Economic growth accounting has been applied to virtually every economy in the world and a common finding is that the measured growth in the standard of living/levels of economic growth cannot simply be explained entirely by changes in the stock of capital in the economy or labor force growth rates. This led to indications that technological progress rather than mere capital accumulation plays a key role in the economic growth of nation, whilst the lack of it deterring growth.

"*Technological progress became the residual factor explaining long-term growth, and its level was assumed by Solow and other neoclassical growth theorists to be determined exogenously, that is independently of all factors in the model*".[Todaro and Smith: Economic Development]

Economic Nobelist Edward Prescott 1986, elucidated that this unexplained portion of economic growth can be interpreted as a measure of technological progress, and that over time, the Solow Residual fluctuates substantially. Prescott argues that these fluctuations display the importance of technological shocks as a source of business cycle volatility.

2.5 REVIEW OF EMPIRICAL STUDIES

Although there is no empirical literature on the impact of governance on technological progress in Nigeria, Nevertheless some empirical literature have studied the significance of governance and technological progress (total factor productivity) albeit independently. The important findings so far are discussed below.

Akanbi (2011) examined the macroeconomic determinants of technological progress in Nigeria; by carrying out estimation on a time series data from 1970-2006, with the use of Johansen estimation technique. His result posits that instability, the level of financial development, and the level of human development are highly significant determinants of technological progress in Nigeria.

Miller and Upadhyay (2000) investigated openness and trade orientation as potential determinants of total factor productivity in a panel of some developed and developing countries. Their results revealed a higher level of the aforementioned variables allow for greater total factor productivity in those countries.

MuhammedMiah and Adnan Omar(2011) analysed technological progress in developing countries, with their result establishing that developing countries' lack of access to technology and other infrastructure has contributed to their lag behind the new technology development.

JakubGrowiec(2010)analysed 14 different measures of technological progress for 19 OECD countries between 1970-2000,his results therefore established results distinguishing between total factor productivity within each country and at the world technological frontier.

Elsevier B.V (2012)analysed the relationship between technology gap and quality of governance in North African countries over the period of 1970-2005.The empirical results show that the quality of governance is important in closing the technology gap and speeding up the technology catch-up.

Rolf Färe et.al (2009), analyzed productivity growth of 17 OECD countries, using panel data of 1979-1988, and their result thus posited that United States productivity is slightly greater than the average, when the growth is due to technical change while when the change is due to efficiency change Japan's productivity is the highest.

CHAPTER THREE

THEORETICAL FRAMEWORK AND RESEARCH METHODOLOGY

3.0 INTRODUCTION

Substantial economic literature shows that good governance is essential for higher economic performance and for helping to foster innovation and diffusion of new technologies (Easterly and Levine, 1997; Knack and Keefer, 1995; Kormendi and Meguire, 1985; Mauro, 1995; Rodrik et al., 2004). Méon and Weill (2004) test the relationship between governance and technical efficiency for a sample of 62 countries and find that rule of law affects economic efficiency.

Adkins et al. (2002) test the relationship between efficiency and economic freedom and find that the lack of economic freedom results in lower efficiency. It is also argued that openness to foreign markets and high skilled

Labor facilitates the absorption of new technology and helps to faster technological catch-up. For instance, Coe et al. (1997) find that for developing countries foreign R&D spillovers increase with the intensity of trade and quality of the labor force. Iyer et al. (2006) confirm these findings and show that developing countries can increase their technological catch-up by opening up to trade and foreign direct investment. The authors consider that countries with the widest technological gaps can catch up more rapidly through higher FDI inflows, trade liberalization and mobility of human capital.

Also, it is well argued that financial development promotes economic growth (Guiso et al., 2004; Rajan and Zingales, 1998) and allows more efficient allocation of production factors across economic activities (Bertrand et al., 2007; King and Levine, 1993a, b; Rajan and Zingales, 2003).[ImedDrine 2012]

This chapter aims at looking at the relationship of technological progress and good governance in Nigeria. Other significant economic determinants of technological progress in the economy are also examined. The section presents the theoreticalframework, the methodology of the study, model specification and the estimation procedures which would assist in the attainment of the broad purpose of the study.

3.1 THEORETICAL FRAMEWORK

The economic theory which is the basis of this study is the “Endogenous Growth Theory”.

3.1.1 THE ENDOGENOUS GROWTH THEORY

Endogenous growth theory holds that growth in an economy is primarily due to endogenous (determinants within the economy) and not external forces.

The endogenous growth theory was initiated by Paul Romer (1986) in attempt to explain economic growth process differently from the standard neoclassical model which had become increasingly unsatisfactory. In the 1980’s, it became perceptibly clearer that the neoclassical growth models were theoretically inadequate as tools to explore long run

economic growth, as these models predicted economies without technological change and thus eventual convergence to a steady state with zero per capita growth as a result of the diminishing return of capital. Though the advancing economic studies of the time infer long run growth of the economy not be set on exogenously in lieu of endogenous economic agents (i.e. households and firms).

Endogenous growth can be defined as long-run economic growth which is determined by internal economic activities of such economic system, particularly those forces governing the opportunities and incentives to create technological knowledge.

Endogenous growth theory explains an economy's growth in the long run as a result of economic activities that create new technological knowledge and generating technological progress. "*In the long run the rate of economic growth, as measured by the growth rate of output per person, depends on the growth rate of total factor productivity (TFP), which is determined in turn by the rate of technological progress*."[Howitt 1994]

Endogenous growth theory observes that technological progress takes place through innovations, in the form of new products, new markets, and new production processes many of which are effect of economic activities. "*Because firms learn from experience how to produce more efficiently, a higher pace of economic activity can raise the pace of process innovation by giving firms more production experience. Also, because many innovations result from R&D expenditures undertaken by profit-seeking firms, economic policies with respect to trade, competition, education, taxes and intellectual property can influence the rate of innovation by affecting the private costs and benefits of doing R&D*" .[Howitt 1994]

3.2 RESEARCH METHODOLOGY

In view of the fact that the study is to critically examine the effect of governance and other economic determinants on technological progress in Nigeria's economy. The method of analysis would be both quantitative and descriptive in nature. Graphs, trends and regression analysis would be utilized.

3.2.1 CALCULATING THE SOLOW RESIDUAL

Solow assumed a very basic model of annual aggregate output over a year (*t*). He posited that the quantity of output would be governed by the amount of capital, the amount of labor, and the productivity of that labor. He thought that the productivity of labor was the factor driving long-run GDP increases.

Total Factor Productivity (TFP) cannot be measured directly. Instead it is a residual, often called the Solow residual, which accounts for effects in total output not caused by inputs.

Regression analysis and the Solow residual

The most basic technique for doing this is to assume constant rates of change in all the variables (obscured by noise), and regress on the data to find the best estimate of these rates in the historical data available (using an Ordinary least squares regression). Economists always do this by first taking the natural log of their equation (to separate out the variables on the right-hand-side of the equation); logging both sides of this production function produces a simple linear regression with an error term, ε:

$$\ln\big(Y(t)\big) = \alpha \ln\big(K(t)\big) + (1-\alpha)\big[\ln\big(A(t)\big)\big] + \varepsilon.$$

A constant growth factor implies exponential growth in the above variables, so differentiating gives a linear relationship between the growth factors which can be deduced in a simple regression.

In regression analysis, the equation one would estimate is

$$y = C + \beta k + \gamma l + \varepsilon$$

where:

y is (log) output, ln(Y)

k is capital, ln(K)

ℓ is labor, ln(L)

C can be interpreted as the co-efficient on log(A) – the rate of technological change – (1 – α).

3.3 MODEL SPECIFICATION

Given that technological progress in an economy is determined by macro-economic factors other than governance performance. Therefore a multi-variant equation which incorporates governance and other macro-economic determinants is specified to present a liberal symmetry and a more balanced perspective about how technological progress of Nigeria's economy is affected.

We propose to regress technological progress in Nigeria's economy on human capital, financial development, trade openness, foreign direct investment, and the quality of governance.

The timeframe of the study uses annual data from 1996 to 2012.

The general model to be estimated is adapted from;

[Economic Modelling 29 (2012) by ImedDrine. 2155–2162]

$$\text{“}TGR_{it} = \alpha_i + \beta_1 trend_{it} + \beta_2 Education_{it} + \beta_3 FinDev_{it} + \beta_4 Openess_{it} + \beta_5 FDI_{it} + \gamma Inst_{it}\text{”}$$

The computation of TGR_{it} in the specified model above was carried out with the use of Stochastic Production Metafrontier Method with variable inefficiency as proposed by Battes and Coelli (1995).But due to lack of such econometric package for the calculation of technological progress; TGR_{it} specified above, the Solow's residual; A_{it} will be adopted as proxy and without any alterations to the independent variables.

$$“A_{it}= \alpha_i +\beta_0 trend_{it} +\beta_1 Education_{it} +\beta_2 FinDev_{it} +\beta_3 Openess_{it} +\beta_4 FDI_{it} +\gamma Inst_{it}”$$

Where

- *Education* is an indicator on human capital
- *FinDev* is an indicator on financial development and is approximated by the ratio of Credit to Private sector over GDP.
- *Openness* is an indicator of trade liberalization and is defined as the ratio of total exports and imports over GDP.
- *FDI* is defined as the total flows of FDI over GDP
- *Inst* is an indicator of good governance and is defined by the aggregate governance performance over
    1. Voice and Accountability (VA)
    2. Political Stability and Absence of Violence/Terrorism (PV)
    3. Government Effectiveness (GE)
    4. Regulatory Quality (RQ)
    5. Rule of Law (RL)
    6. Control of Corruption (CC)

3.4 EVALUATION CRITERIA

The evaluation consists of deciding whether the estimates of the parameters are theoretically meaningful and statistically satisfactory. For this reasons, the tests of analysis that will be employed in this research work includes the Economic a-priori criteria and statistical criteria.

3.4.1 APRIORI EXPECTATION

These are determined by the principles of economic theory and refer to the sign and the size of the parameters of economic relationships. Drawn from the model, our a-priori expectations or the expected pattern of behavior of the independent variables

$$\beta_1 > 0, \beta_2 > 0, \beta_3 > 0, \beta_4 > 0, \gamma > 0$$

- The above $\beta_1>0$ implies a positive relationship between technological progress and Education
- $B_2>0$ implies that a positive relationship exist between technological progress and financial development (FinDev).
- $B_3>0$ implies that a positive relationship exist between technological progress and trade liberalization (Openness)
- $B_4>0$ implies that a positive relationship exist between technological progress and FDI
- $\gamma>0$ implies that a positive relationship exist between technological progress and good governance (Inst)

3.4.2 STATISTICAL CRITERIA

These are determined by statistical theory and aim at the evaluation of the statistical reliability of the estimates of the parameters of the model. There are several tests for this purpose, e.g., t-statistic, f-statistic, coefficient of determination (R^2) and the adjusted coefficient of determination(R^2), Durbin-Watson (DW).

The t-Test

The t-test is used by econometricians usually to test hypotheses about individual regression slope coefficients. All explanatory variables in this work are considered in order to determine their relationship with foreign direct investment. Hence, it is used to test the statistical significant of the estimated parameter.

To decide whether to reject or not to reject a null hypothesis based on a calculated t-value, a critical t-value is used. A critical t-value is the value that distinguishes the "acceptance" region from the rejection region. The critical t-value, $t_{c,}$ is selected from a t-table. Once a calculated t-value t_k and a critical t-value t_c has been obtained, we reject the null hypothesis if the calculated t-value is greater in absolute value than the critical t-value and if the calculated t-value has the sign implied by the alternative hypothesis.

Thus, the rule to apply when testing a single regression coefficient is that we should test for:

Coefficient Of Determination (R^2)

The simplest commonly used measure of fit is R^2 or the coefficient of determination. It is the ratio of the explained sum of squares to the total sum of squares:

$$R^2 = \frac{ESS}{TSS} = 1 - \frac{RSS}{TSS}$$

The higher the R^2 is, the closer the estimated regression equation fits the sample data. Measures of this type are called "goodness of fit" measures. Since OLS selects the coefficient estimates that minimize RSS, OLS provides the largest possible R^2, given a linear model. Since TSS, RSS, and ESS are all nonnegative (being squared deviations), R^2 must lay in

the interval $0 \leq R^2$ 1. A value of R^2 close to 1 shows an excellent overall fit, whereas a value near zero shows a failure of the estimated regression equation to explain the values of dependent variable.

The F Statistics

This is used to test for the statistical significance of the entire slope coefficient jointly on the dependent variable using level of significance. It is done by comparing the F cal with the F tabulated and when the F cal is greater than the F table we reject the null hypothesis.

Durbin-Watson Test

It is usually used to test for serial/auto correlation. The Durbin-Watson statistics is used to test for serial correlation in a model and this is done by comparing the Durbin-Watson from the model to the critical value of 5% ,furthermore if the Durbin-Watson lies between the upper limit and four minus upper limit i.e. (u<dw<4-du), we then reject the null hypothesis at the 5 percent level of significance and conclude that there is no autocorrelation in the model.

3.5 RESTATEMENT OF HYPOTHESIS

- H_0: There is no significant relationship between economic performance, good governance and technological progress
- H_1: There is a significant relationship between economic performance, good governance and technological progress

3.6 LIMITATIONS OF THE STUDY

The major limitation to our study was the lack of adequate data, to extend the scope of study, from a period of 17 years (1996-2012), to a larger scope of study.

CHAPTER FOUR

DATA ANALYSIS AND PRESENTATION

4.0 INTRODUCTION

The determination of the significance of macroeconomic determinants and good governance on technological progress in Nigeria is analyzed based on the specified models in chapter three. In capturing this precise link, technological progress is regressed on governance performance and other macroeconomic factors; Education, financial development, trade openness and FDIwhich are considered significant in economic development and technological progress at large.

The time frame of the data used in the study was 1996 – 2012. The OLS is employed in estimating the model.

4.1 COMPUTATION OF THE SOLOW RESIDUAL

Firstly, we look at the estimated level of technological progress in the economy since 1996. The Solow's residual (which has been comprehensively elucidated in the theoretical framework) was used to measure technological progress in the economy in regression analysis; $y = C + \beta_1 k + \beta_2 l + \varepsilon$.

The ***e-view*** format is given in logarithmic form as

$$\ln\big(Y(t)\big) = \alpha \ln\big(K(t)\big) + (1-\alpha)\big[\ln\big(A(t)\big)\big] + \varepsilon$$

The table below shows the estimated technological progress in the economy

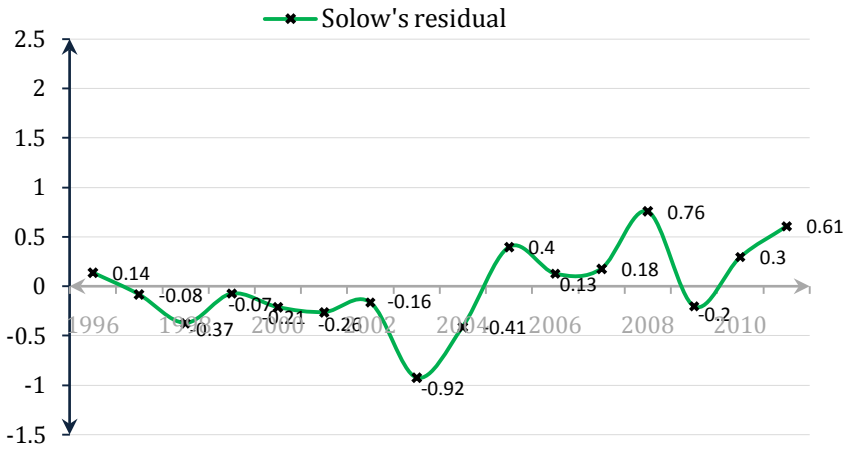
TABLE1 4.1.1

Year	Estimated residual
1996	0.141287161
1997	-0.077689296
1998	-0.372743714
1999	-0.065013781
2000	-0.020506296
2001	-0.258825846
2002	-0.159240065
2003	-0.92163276
2004	-0.41118515
2005	0.380448169
2006	0.132077039
2007	0.184185411
2008	0.756764758
2009	-0.201391507
2010	0.291755245
2011	0.601710633
2012	0.601510411

Source: author's computation

Further illustration by chart showing the estimated technological progress in the economy since 1996

FIGURE 4.1.1



The estimated Solow's residual of the economy has flitted between the region of -1% and 1%. Arguably at least 99% of output growth in the economy is accounted for by increase in the input of production factors; **Capital(K)** and **Labor(L).** The contribution of technological progress/total factor productivity (Solow's residual; **A**) to the economy's growth has been extremely minimal. This might be due to the fact that increase in the Solow's residual in the economy has been almost 0% since 1996.

4.2 REGRESSION OUTPUT

TABLE 4.2.1

	REGRESSION RESULTS		
Variables	Coefficients	T- statistic	Probability
C	**-4.723934**	**-3.036673**	**0.0039**
EDU	**0.327741**	**5.491556**	**0.0000**
FDI	**6.538516**	**1.201557**	**0.2357**
TRD_OPN	**1.155376**	**2.043516**	**0.0468**
CRP	**-11.38555**	**-1.364137**	**0.1792**
GOV	**-0.097868**	**-2.671957**	**0.0104**
R-squared	**0.817758**		
Adjusted R-squared	**0.800805**		
Durbin-Watson stat.	**2.719538**		
F-statistic	**48.23740**		
Prob.(F-statistic)	**0.000000**		

Source: author's computation

$$A_{it} = -4.723934 + 6.538516FDI + 0.327741EDU - 11.38555CRP + 1.155376TRD\_OPN - 0.097868GOV + \mu$$

The apriori criteria expected is that all coefficients are greater in value than zero;

- (EDU) Education ; $\beta_1 > 0$
- (FDI) Foreign Direct Investments; $\beta_2 > 0$
- (TRD_OPN)Trade Openness; $\beta_3 > 0$
- (CRP) Credit to Private Sector; $\beta_4 > 0$
- (GOV)Good Governance; $\gamma > 0$

According to the model estimated, we find that two of the five coefficients; CRP and GOV did not follow the apriori expectation, indicating a negative relationship with technological progress (A).

Although the estimated significance which the independent variables; Credit to private sector **[β_2FinDev]**and governance [**γInst]**did not meet the expected apriori criteria**.**

We shall analyze probable grounds for each of the estimated coefficient's significance to technological progress in Nigeria's economy.

4.3 QUALITATIVE AND QUANTITATIVE ANALYSIS

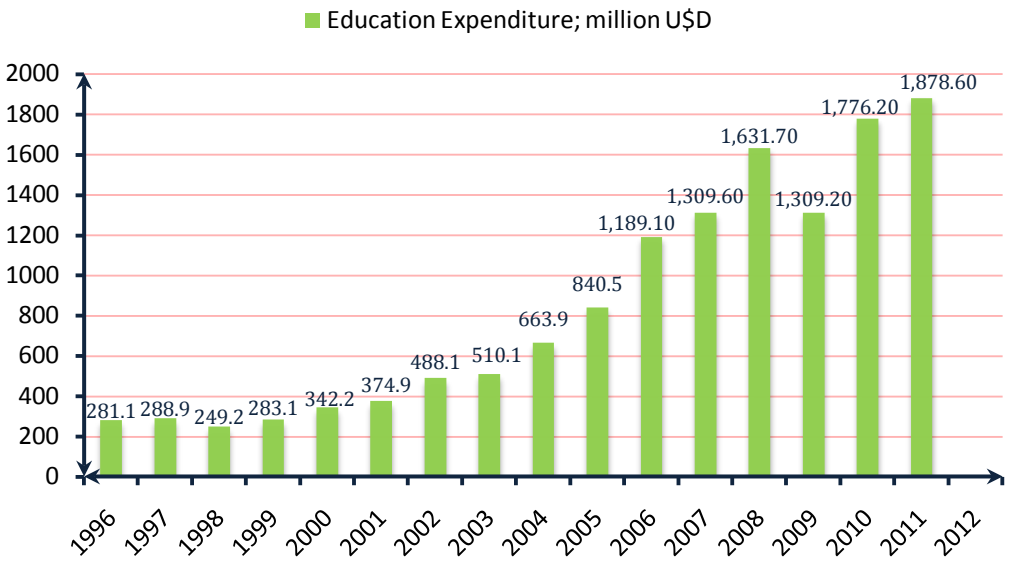
Model Estimated

$$A_{it} = -4.723934 + 6.538516FDI + 0.327741EDU - 11.38555CRP + 1.155376TRD\_OPN - 0.097868GOV + \mu$$

4.3.1 EDUCATION[EDU] AS A MACROECONOMIC DETERMINANT OF TECHNOLOGICAL PROGRESS

A. QUALITATIVE ANALYSIS

FIGURE 4.3.1



The chart above shows the gradual rise in overall education expenditure in the economy. Increasing level of investment into the educational industry in Nigeria, both from the public and private sector has invariably contributed to human capital development and has positive effect on technological progress in Nigeria.

B. QUANTITATIVE ANALYSIS

From the model estimated, we find that the coefficient of education (**EDU; 0.327741**) conforms to the apriori expectation **[$\beta_1 > 0$]** as it is greater in value than zero.

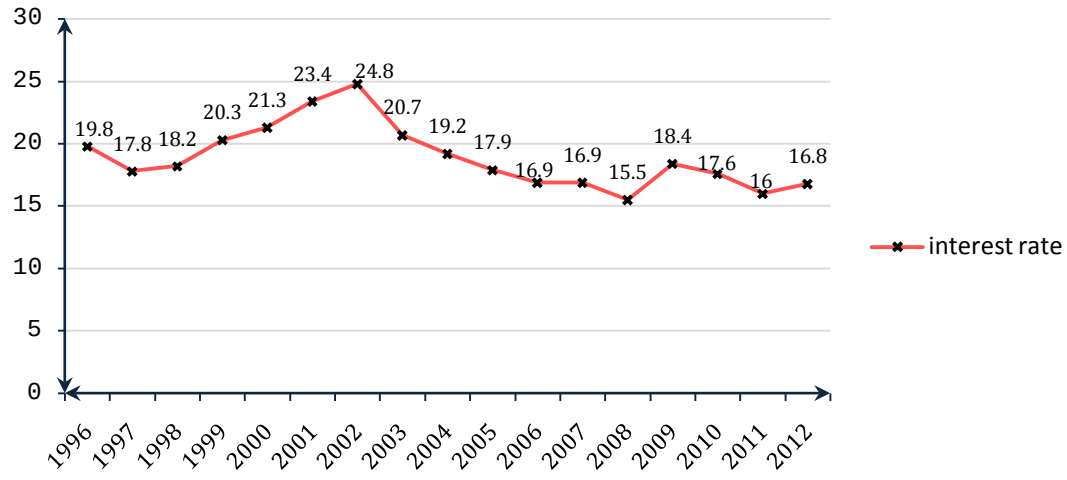
The estimated coefficient therefore implies a positive relationship between education and technological progress in Nigeria. And that increase in education expenditure would be expected to cause 0.3277 increasing technological progress in Nigeria.

4.3.2 FINANCIAL DEVELOPMENT [CRP] AS A MACROECONOMIC DETERMINANT OF TECHNOLOGICAL PROGRESS

A. QUALITATIVE ANALYSIS

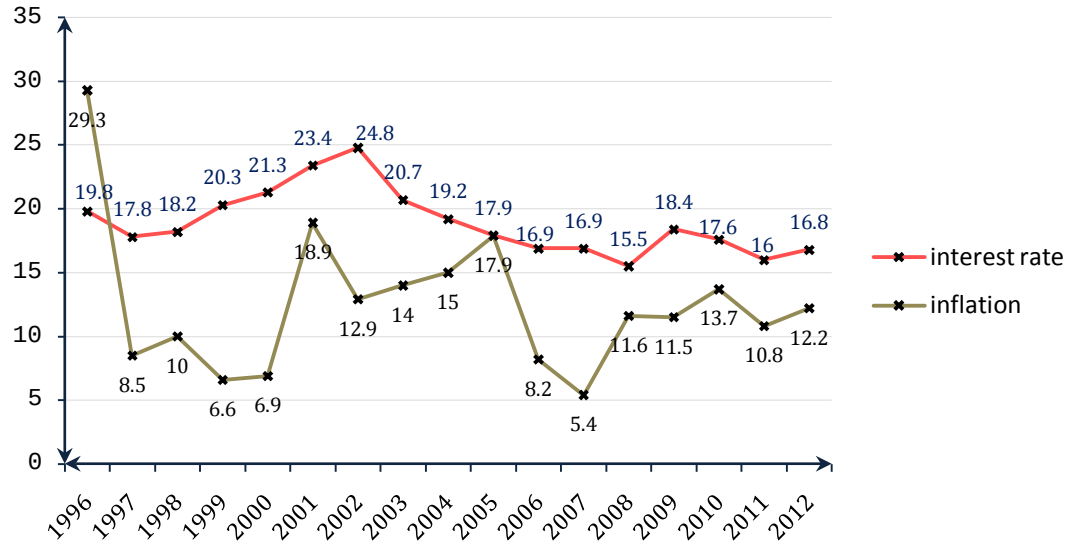
The trend below shows interest rate levels in the economy since 1996

FIGURE 4.3.2



The history of high interest rate levels in the economy is certainly not favourable to the availability of credit to the private sector, nor does it encourage financial development. One could argue that such monetary policies are implemented strategically to curb inflation. However, considering the chart below

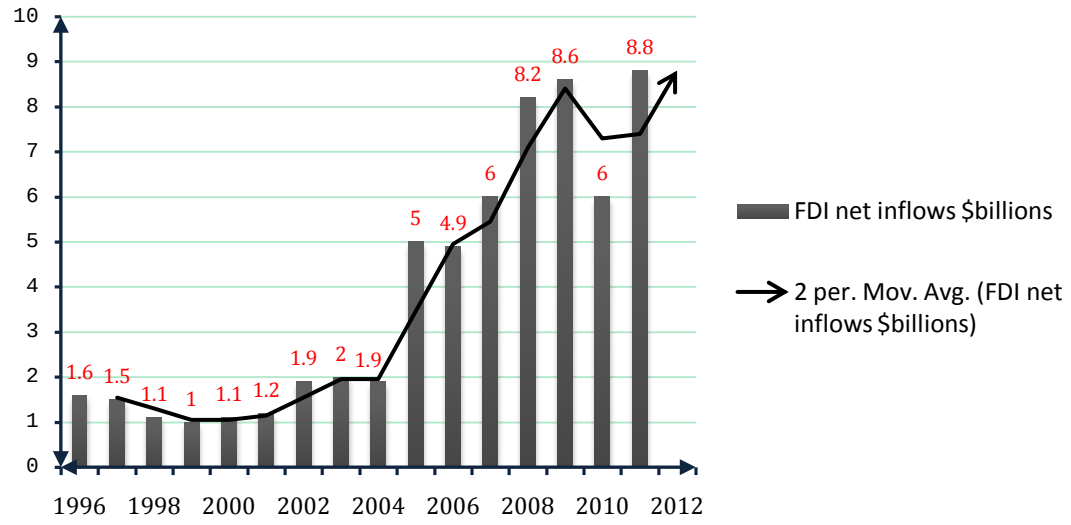
FIGURE 4.3.3



We can presume that the high interest rate levels have not kept inflation rates at moderate levels. Inadvertently, it might even be partly responsible for the high inflation rate in the economy as high interest rate levels increases production cost for firms.

Nevertheless, the high interest rate level of the economy seems favourable for the attraction of foreign capital inflow.

FIGURE 4.3.4



Foreign capital inflow is important for an economy as it enables growth. However, growth in Nigerian economy is mostly superficial; as questions are still being asked about the persistent high levels of inequality, unemployment and poverty in the economy.

The majority of multi-national corporations in Nigeria's economy are involved mostly in mineral extraction and production of primary goods. Due to their large economies of scale, credit is easily accessible to them. Small firms and entrepreneurs on the other hand are unable to access credit because it is too expensive. The beneficiaries of this arrangement are the elite and MNCs.

The result of this is an economy unable to evolve from its primary goods production state (for the production of primary goods mostly crude oil and unprocessed agriculture products is the place of Nigeria's economy on the international trade scene), and incapable of generating innovations and manufacturing of technological products.

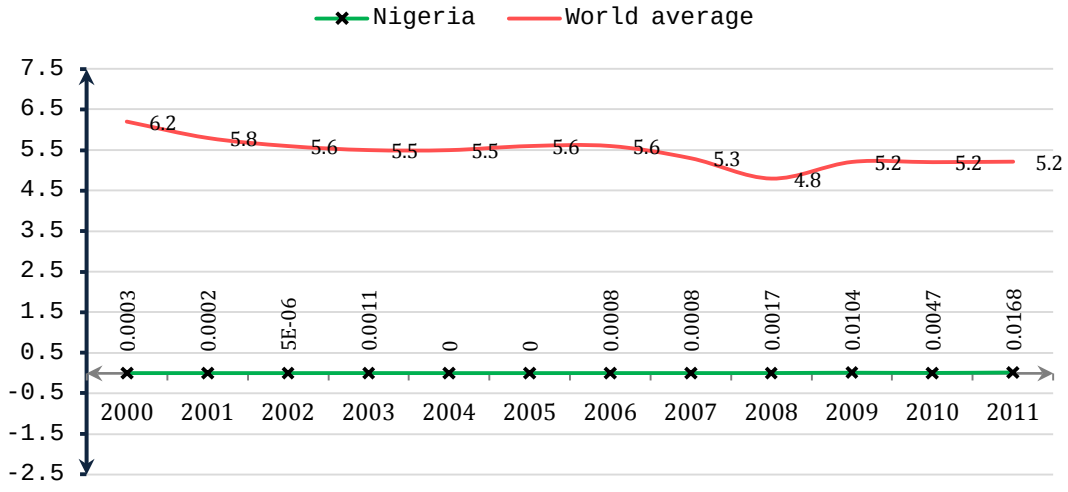
TABLE 4.3.3

ICT GOODS PERCENTAGE OF TOTAL EXPORT

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Nigeria	0.0003	0.0002	0.00005	0.0011	0	0	0.0008	0.0008	0.0017	0.0104	0.0047	0.0168
World Average	6.2	5.8	5.6	5.5	5.5	5.6	5.6	5.3	4.8	5.2	5.2	5.2

Source: world Bank

FIGURE 4.3.5



From the above data, we note that despite the increasing inflow of capital, production of ICT goods in the economy is almost at zero % of total exports, and in some years we find that the economy produced virtually nothing of such.

B. QUANTITATIVE ANALYSIS

The estimated model finds that the coefficient of financial development (**CRP; -11.3855**) does not conform to the a priori expectation [$\beta_4 > 0$] as it is less in value than zero

This therefore implies a negative relationship between CRP and technological progress in Nigeria. And that an increase in the available credit to private sector will lead to a 11.385 percentage decline in technological progress in the economy.

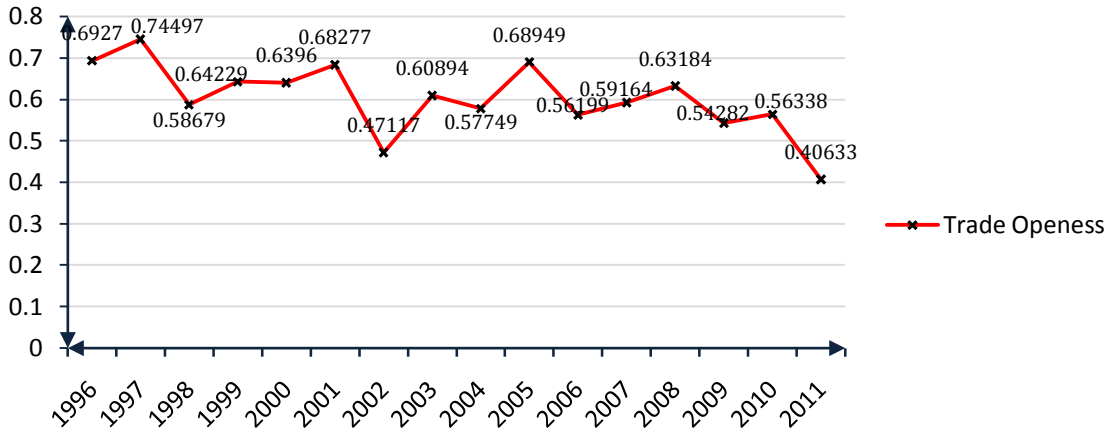
This estimated negative significance which credit to private sector has on technological progress is not in agreement with contemporary economic literature. Probable grounds for the estimated result have been explicated in qualitative analysis.

4.3.3 TRADE OPENESS [TRD_OPN] AS A MACROECONOMIC DETERMINANT OF TECHNOLOGICAL PROGRESS

A. QUALITATIVE ANALYSIS

The trend below shows trade openness of the economy measured by the ratio of total exports and imports over GDP.

FIGURE 4.3.6



B. QUANTITATIVE ANALYSIS

From the model estimated, we find that the coefficient of trade openness (**TRD_OPN; 1.155376**) conforms to the a priori expectation [$\beta_3 > 0$] as it is greater in value than zero.

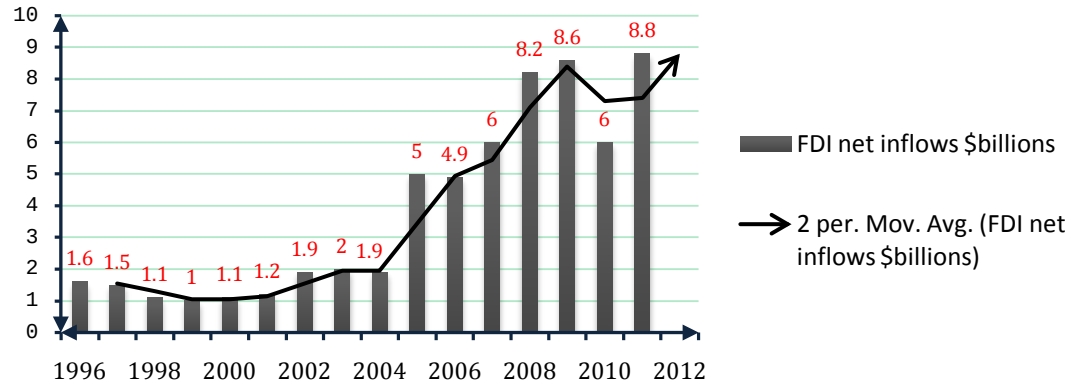
The estimated coefficient therefore implies a positive relationship between trade openness of the economy and technological progress in Nigeria.

4.3.4 FOREIGN DIRECT INVESTMENTS [FDI] AS A MACROECONOMIC DETERMINANT OF TECHNOLOGICAL PROGRESS

A. QUALITATIVE ANALYSIS

The trend below shows increasing Foreign Direct Investments into the Nigerian economy since 1996

FIGURE 4.3.7



B. QUANTITATIVE ANALYSIS

From the model estimated, we find that the coefficient of FDI (**FDI; 6.538**) conforms to the apriori expectation **[$\beta_2 > 0$]** as it is greater in value than zero.

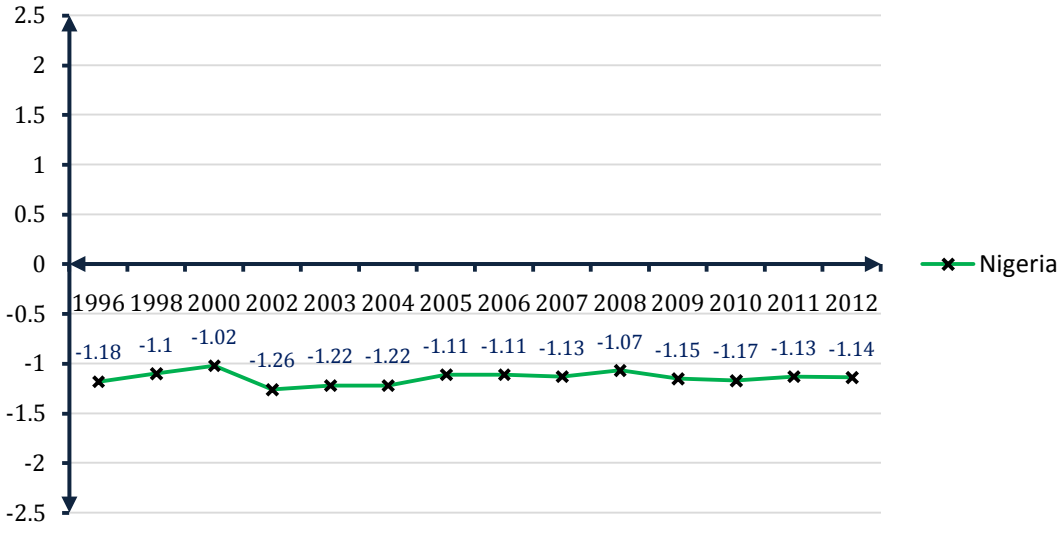
The estimated coefficient therefore implies a positive relationship between FDI and technological progress in Nigeria. And that increase in foreign direct investment would be expected to cause 6.538 increases in technological progress in Nigeria.

4.3.5 THE PERFORMANCE OF GOVERNANCE [GOV] IN NIGERIA

A. QUALITATIVE ANALYSIS

This chart illustrates aggregate governance performance in Nigeria as measured by WGI

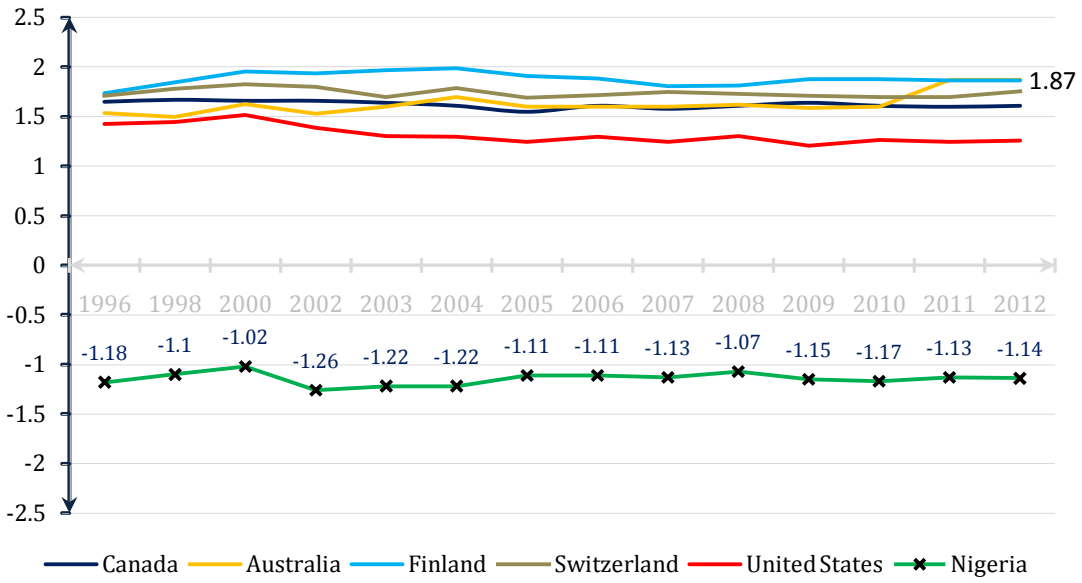
FIGURE 4.3.8



From the above data, we can deduce that governance performance in Nigeria is negative and evidently below par.

In comparison with some of the most technologically advanced countries, we note that such countries governance performance is positive and well above average.

FIGURE 4.3.9



We can infer that Nigeria's negative governance statistics might be a probable cause for the estimated negative relationship with technological progress. That is, positive governance affects technological growth positively whilst negative governance performance leads to negative technological progress.

Also, we have to consider the system of Nigeria's economy; which is *mixed economy*. The Nigerian economy features a mixture of capitalist enterprise and government control. Although this form of economic system is thought to overcome the disadvantages of both capitalist and socialist economy, however in the case of Nigeria, this system has evidently not realized whatever benefits assumed to be inherent in this system.

The lack of definitive borderline principles or theories expressing where in the economy socialism ends and where capitalism begins and what defines an appropriate mixture of both has played conveniently into the hands of corrupt individuals occupying government. As illustrated above by the poor performance of Nigeria in the World Governance Indicators, the prevalence of bad governance is seen over the years.

This combination undermines the efficiency of private property, decimates competitive market mechanism as a result of government continuous intervention and bureaucratic controls, encourages state monopolies which are mostly lethargic and inefficient leading to market failure, frustrates international trade and globalization by implementing unfair trade policies influenced by selfish interests in government. Ultimately, the composition of Nigeria's economic system ensures it is unsuccessful in attaining efficient economic development objectives neither through competitive market system nor socialistic design. So long as there is a prevalence of intrinsic government corruption, the economy will be inexpedient for technological progress.

B. QUANTITATIVE ANALYSIS

The model estimated finds that the coefficient of governance (**GOV; -0.0978**) does not conform to the apriori expectation **y> 0**, as the estimated coefficient is less than zero.

This therefore implies that a negative relationship exists between technological progress(A) and governance in Nigeria. And that a percentage increase in good governance will lead to a -0.0978 percentage deterioration of total factor productivity and technological progress in the economy.

The negative political and governance conditions in Nigeria are not conducive for technological progress to thrive.

4.4 STATISTICAL ANALYSIS

4.4.1 COEFFICIENT OF DETERMINATION (R^2) AND ADJUSTED R - SQUARED: R squared is of the value 0.817758 showing that the independent variables explicate 81.7% of the total variation in FDI. Adjusted R^2 is 0.800805showing the independent variables explicate 80.1% of variation in the dependent variable (technological progress).

4.4.2 F-STATISTICS: Model Goodness of Fit

The F-statistic reported in the lower panel of the table gives the goodness of fit of the model. The F-statistic is approximately48.23740. The significance of this value implies that the data used in the estimation fits well into the regression equation; it therefore shows that the estimate of the parameters is significant. This is good for forecasting and policy making on issues pertaining to real GDP in the Nigerian economy.

4.4.3 DURBIN WATSON STATISTICS: this is 2.719538, reveals the presence of no amount of auto-correlation hence we accept the null hypothesis for the absence of autocorrelation among the disturbance terms in the model. Furthermore the Durbin Watson statistics shows that the model is a strong one since the D.W stat is greater than the R-square.

4.4.4 T-STATISTIC

TABLE 4.5.1

Variable	t-calculated	t-tabulated	P-value	Decision
EDU	**5.491556**	2.064*	**0.0000**	Reject Ho
FDI	**1.201557**	2.064*	**0.2357**	Accept Ho
TRD_OPN	**2.043516**	2.064*	**0.0468**	Accept Ho
CRP	**-1.364137**	2.064*	**0.1792**	Accept Ho

GOV	**-2.671957**	2.064*	**0.0104**	Reject Ho

Source: author's computation

The t-stat value of education expenditure (EDU) reveal that it has a significant impact on technological progress in Nigeria, as its p-value is 0.0000, which is greater than the 5% significance level, thus meaning that we reject the decision rule of the variable being statistically insignificant on technological progress in Nigeria.

More also the t-stat value of governance reveals also that there is a significant relationship between GOV and technological progress in Nigeria, hence the p-value being 0.0104 which is greater than the 5% significance level.

However on the other hand the t-stat values of FDI, TRD_OPN and CRP reveal that they are all statistically insignificant affecting the level of technological progress in the country. This is as a result of their t—stat value of 1.20155, 2.0435 and 1.364 respectively were all less than the tabulated t-stat, hence ensuring that their p-value was insignificant statistically at 5% significance level.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.0 INTRODUCTION

This chapter gives a summary of the research work establishing the conclusions and proffering recommendations on policies that affects the research topic.

5.1 SUMMARY

Economic literature stresses that technological progress is of great importance for industrialization and eventual development of any economy. Unfortunately, technological progress in particular with the Nigerian economy is grossly understudied.

This paper sought to investigate the level of technological progress in the Nigerian economy and how it is affected by governance performance and other significant macroeconomic determinants such as Education, Foreign Direct Investments, economy's Financial Development and Trade Openness.

The empirical finding of this paper establishes that the contribution of technological progress to the economy's growth has been extremely minimal. Growth of Nigeria's economy can be almost singularly accounted for by increase in factor input in production. Also, we find that Nigerian governance performance and the level of credit to private sector has a negative relationship with technological progress. While increasing Foreign Direct Investments, expenditure on Education and Trade Openness appears to have significant impact on technological progress in Nigeria. Moreover, education and governace was found to be most significant in impacting technological progress in the economy.

5.2 RECOMMENDATION

These findings can be taken to underline important policy measures which would aid technological catch-up of the Nigerian economy.

Hence policies that increase the availability of credit to the private sector, particularly in regards to domestic interest rate levels with a view to making credit accessible and inexpensive to domestic entrepreneurs and local firms and also directing it to certain industries with forward and backward linkages should be adopted by the Nigerian government. As this would assist productive domestic firms obtain finance less costly, encourage healthy market competition and ensure that the economy becomes more productive in the long run, which would invariably affect the level of technological progress in the country.

Also, technological progress of the economy can be increased if measures are taken to improve the quality of governance in the country and the effectiveness of public institutions. Although our result reveals that governance has statistical significant impact on technological progress, conversely this impact is negative; this thus reveals the true situation of the country, as the negative performance of governance in Nigeria is amongst the worst in the world. The populace should strive and work together to ensure that the representative system of government actually works. Qualified and competent electoral candidates should be supported irrespective of political parties. Furthermore, effective strategies which ensure

that electoral committees are accountable and effective should be implemented by policy makers to ensure true democracy.

More also, progressive and liberal trade policies should be incorporated by policy makers as this would allow for market competition, market specialization and also help consolidate the technological gap by fostering foreign technology diffusion and adaptation.

Furthermore policy makers should ensure that policies favorable towards foreign capital inflow should be implemented by the government, since our result reveal that FDI has a positive relationship with technological progress. However, such capital inflow should be incentivized into diverse sectors of the economy and not focused majorly on just the primary sector. Foreign capital investments into various sectors of the economy such as transportation, healthcare, manufacturing etc. would help spur productivity and technological progress in these sectors.

Finally, the significance of Education on the economy cannot be overstated. It is the backbone of technological progress. Government and policy makers should implement policies which increases the availability of quality education to Nigeria's large and increasing populace. Implementation of such policies would be of great significance in accumulating human capital in the economy and cultivating Nigeria's huge labor force towards attracting multinational corporations, production outsource into the Nigerian economy from advanced economies as this would increase employment opportunities, foster industrialization and ultimately technological progress and economic development.

5.3 CONCLUSION

This study has presented both statistical and descriptive analysis on the relationship between macroeconomic determinants and governance performance on technological progress in Nigeria. Examination of macroeconomic and governance indicators show significant relationship on technological progress in the country.

However the general consideration indicates very low level of technological progress in the Nigerian economy. Therefore technological catch-up of the domestic economy can be achieved provided positive governance performances in Nigeria is seen, coupled with increases in the level of trade openness, available credit to private sector, increase foreign direct investments and expenditure on education.

BIBLIOGRAPHY

AyodeleAkanbi [2011] "The Macroeconomic Determinants Of Technological Progress In Nigeria"

Akinlo, E. A. (1996), Improving the Performance of the Nigerian Manufacturing Sub-Sector after Adjustment, *the Nigerian Journal of Economic and Social Studies*, Page 9.

Akinlo, A.E. 2006.Macroeconomic factors and total factor productivity in sub-Saharan African countries. *International Research Journal of Finance and Economics*, 1:62-79.

Abramovitz, M,[1986]. "Catching-up;Forging Ahead, and Falling Behind" *Journal of Economic History*, Vol. 46, n2, pp. 385-406.

Adeola F. Adenikinju [2005] "Productivity performance in developing countries Country; case studies Nigeria"

Ayonrinde, F.O., O. Adenikinju and A. Adenikinju [1998] "The Impact of Trade Liberalization on Technological Acquisition in Nigerian Manufacturing Sector".*Journal of Economic Management.*Vol. 5 no. 2. pp. 67-88.

Adenikinju, A. and C. Soludo (1997), "Economic Policy and Total Factor Productivity in Nigeria's Manufacturing Sector",*OECD Development Centre, Paris*

Adenikinju, A.F. and L.N. Chete [1999] "Trade Liberalization, Market Structure and Productivity in Nigeria".*The Nigerian Journal of Economic and Social Studies*.Vol. 41.no. 3. pp 385-403

Adenikinju, A.F. [1998] "Government Investment and Manufacturing Performance in Nigeria" Nigeria Economic Society, Rekindling Investment for Economic Development in Nigeria.Selected Papers for the 1998 Annual Conference. Chapter 14, pp. 303-319

Aoki, Masahiko, Hyung-Ki Kim and Masahiro Okuno-Fujiwara (eds) [1997]. The Role of Government in East Asian Economic Development: Comparative Institutional Analysis. Oxford: Clarendon Press.

Bencivenga, V., B. Smith, R. Starr, [1995]."Transactions Costs, Technological Choice, and Endogenous Growth".*Journal of Economic Theory*, 67, 153-177.

Bencivenga, V., and B. Smith, [1991]."Financial Intermediation and Endogenous Growth".*Review of Economic Studies*, 58, 195-209.

BichakaFayissa, Nsiah [2010] "The Impact of Governance on Economic Growth: Further Evidence for Africa"

Borensztein, E., J. DeGregorio and J.W. Lee (1998), "How Does FDI affect Economic Growth?".*Journal of International Economics,*Vol. 45 pp115-135.

Collier, P. and J.W. Gunning. [1999] "Explaining African Economic Performance," *Journal of Economic Literature*

C. M. Anyanwu "Productivity In The Nigerian Manufacturing Industry" *Research Department, Central Bank Of Nigeria*

DaronAcemoglu, Veronica Guerrieri July [2004] "Labor-Augmenting and Skill-Biased Technical Change"

DEVEREUX, M. and LAPHAM, B. (1994) "The Stability of Economic Integration and Endogenous Growth".*The Quarterly Journal of Economics*, 109,299-305

Dike, E. "1995". "Sources of long-run economic growth in Nigeria: A study in growth accounting". *African Development Review*, 7(1):76-87

Edwards, S. [1998] "Openness, productivity and growth: what do we really know?" *The Economic Journal, 108:383-398.*

Easterly, W, and Levine, R. (2003), "Tropics, Germs, and Crops: How Endowments Influence Economic Development", *Journal of Monetary Economics*, 50: 3-39.

Feng, Y. [2003], Democracy, Governance and Economic Performance: Theory and Evidence, *Cambridge: MA, MIT Press*

Francesco Pigliaru [1999] "Detecting Technological Catch-Up In Economic Convergence" *Università di Cagliari Italy*.

Fabio Manca [2009] "Technology Catching-up and the Role of Institutions" *Research Institute of Applied Economics*

Fernald, John G. and ShanathiRamnath.[2004] "The Acceleration in U.S. Total Factor Productivity after 1995: The Role of IT." *Economic Perspectives.*

Global Economic Prospects [2008] Technology and Technological Diffusion in Developing Countries

Glaeser et al. [2004], Do Institutions Cause Growth? *Journal of Economic Growth*, 9(3): 271-303.

Greenwood, J., and B. Jovanovic, [1990]."Financial Development, Growth, and the Distribution of Income".*Journal of Political Economy*, 98, 1076-1107

Hall, R., and D. Jones,1999. "Why Do Countries Produce So Much More Output Per Worker ThanOthers?" *Quarterly Journal of Economics*, 83-116.

Heckman, J., [2002]. "China's Investment in Human Capital," *NBER Working Paper* 9296,

Hicks, R., [1969]."A Theory of Economic History". Clarendon Press, Oxford, U.K

Hultberg, P.T., Nadiri, M.I., Sickles, R.C., [1999]. "An international comparison of technology adoption and efficiency: a dynamic panel model"

Isoun, T. T. [2004]. "Science and Technology Reforms in Nigeria".

ImedDrine [2012] "Institutions, governance and technology catch-up in North Africa*" Economic Modelling* 29 2155–2162

Jean-Jacques Dethier [1999]: "Governance and Economic Performance: A Survey". *ZEF – Discussion Papers on Development Policy.*

Jean-Jacques Dethier [1999] "Governance and Economic Performance"

Jeffrey D. Sachs and John W. McArthur [2004] Technological Advancement and Long-Term Economic Growth in Asia

JakubGrowiec [2010] "On the measurement of technologicalprogress across countries" *National Bank Of Poland Working Paper No . 7 3*

Kim, J.I. & Lau L.J. [1994] "The sources of economic growth of the East Asian newly industrialized countries". *Journal of Japanese International Economics, 8:235-271.*

Khan, S.U. [2006]. Macro determinants of total factor productivity in Pakistan*. State Bank of Pakistan Research Bulletin, 2(2):383-401*

Knack, S. (Ed.) [2003], Democracy, Governance and Growth, Ann Arbor: *The University of Michigan Press.*

Kormendi, R., and Meguire, P. [1985], Macroeconomic Determinants of Growth, *Journal of Monetary Economics, 16: 141-63.*

Krugman, P., [1993]. "International Finance and Economic Development".in A. Giovannini (ed.) Finance *and Development: Issues and Experience, Cambridge University Press, Cambridge, UK.*

Knowledge and detour for sustained catch-up Shupeterian Analysis of the Asian experience

Lee, Keun, and Yoon, M. (2004), "Inter-national and Intra-national Knowledge Diffusion and Technological Catch-up",

Mankiw, G., D. Romer, and D. Weil, [1992]."A Contribution to the Empirics of Economic Growth".*Quarterly Journal of Economics*, 407-38.

MonchiLio and Meng-Chun Liu (2006). "ICT and Agricultural Productivity, Evidence from Cross-Country Data." *Agricultural Economics 34.3 221-244.*

Mayer, J. (2001), "Technology-diffusion, Human Capital and Economic Growth in Developing Countries".*UNCTAD Discussion Papers* No.154

Mlawa, H.M. [1999] "Technology Policies for Sustainable Development in Eastern Africa: Kenya, Tanzania, Zambia and Zimbabwe" DUP Press.

Mushtaq H. Khan [2006] "Governance, Economic Growth and Development since the 1960s" *Background paper for World Economic and Social Survey.*

MuhammedMiah,Adnan Omar [2011] "Digital Age: Technology Progress in Developing Countries" *Information Systems Educators Conference.* North Carolina, USA

Nelson, R. and E.S. Phelps.[1966]. "Investment in Humans, Technological Diffusion, and Economic Growth", *American Economic Review*, 56, 69-75.

Nicole Maldonado [2010] "The World Bank's Evolving Concept Of Good Governance And Its Impact On Human Rights" Osoba, A. M [1983] "Productivity in Nigeria" *PPIPB and NISER*

OECD (1992), Technology and Economy: the Key Relationships, Paris: OECD

Ogunleye, E. &Ayeni, R. [2008]. "The link between export and total factor productivity: Evidence from Nigeria". *International Research Journal of Finance and Economics, 22:83-91.*

Peretto, P. (1999) "Cost Reduction, Entry, and the Interdependence of Market Structure and Economic Growth". *Journal of Monetary Economics*, 43, 173-195.

Peretto, P. (2003) Endogenous Market Structure, and the Growth and Welfare E¤ects of Economic Integration.*Journal of International Economics,* 60, 177-201.

Rivera-Batiz, L. and Romer, P. (1991) "Economic Integration and Endogenous Growth".*The Quarterly Journal of Economics*, 106, 531-556.

Robert M. Solow[1957] The MIT Press : "Technical Change and the Aggregate Production Function"

Rachel Gricth,Stephen Redding and Helen Simpson [2008] "Technological Catch-up and the Role of Multinationals"

Romer, P.M.[1990]. Endogenous technologicalchange.*Journal of Political Economy, 98(5):71-102.*

René Kemp* and SaeedParto [2005]: "Governance for sustainable development: moving from theory to practice "

Rolf Färe, Shawna Grosskopf, Mary Norris, Zhongyang Zhang [Mar, 1994] "Productivity Growth, Technical Progress, and Efficiency Change in Industrialized Countries": *The American Economic Review,* Vol. 84, No. 1 , pp. 66-83

Sebastian DellepianeAvellaneda [2006]: "Good Governance, Institutions and Economic Development: Beyond the Conventional Wisdom"

Sachs, J. [1998] 'Foreign direct investment in Africa', *The Africa Competitiveness Report, Geneva: World Economic Forum*

Sachs, J. [2001], Tropical Underdevelopment, NBER Working Paper No. 8119

Teal, F [1999] "The Ghanian Manufacturing Sector 1991-1995: Firm Growth, Productivity and Convergence," in *Journal of Development Studies* 36(1)

Udo-Aka, U. (1983), "Measuring productivity: Issues and Problems in Productivity in Nigeria", , Edited by Osoba, A.M., Page 75.

UNIDO/CSAE (2002), The Performance of Nigerian Manufacturing Firms: Report on the Nigerian Manufacturing Enterprises Survey 2001. A Report Prepared by M. Soderbom and F. Teal.

UNCTAD July [2003] "AFRICA'S TECHNOLOGY GAP. Case Studies on Kenya, Ghana, Uganda and Tanzania"

UNCTAD [1998] "World Investment Report: Trends and Determinants", Geneva: United Nations.

V. O. Uwaifo, and P. S. O. Uddin [2009] "Technology and Development in Nigeria: The Missing Link"

World Bank [1993], The East Asian Miracle. Economic Growth and Public Policy, Oxford: Oxford University Press.

Wade, R. [1990], "Governing the Market: Economic Theory and the Role of Government in East Asian Industrialization", Princeton, NJ: Princeton University Press

APPENDIX 1

YEAR	TRD OPN	EDUCATION	FDI	CRP	GOV	TP
1996	0.6927	281080550	1593459222	238596.56	23.6	0.131094
1997	0.74497	288942278.8	1539445718	316207.08		0.078591
1998	0.58679	249197494.3	1051326217	351956.19	22	-0.105882
1999	0.64229	283052908.9	1004916719	431168.36		-0.095215
2000	0.6396	342174251.1	1140137660	530373.3	20.4	0.027109
2001	0.68277	374908743.2	1190632024	764961.52		-0.039091
2002	0.47117	448088460.4	1874042130	930493.93	25.2	-0.038929
2003	0.60894	509967240.3	2005390033	1096535.57	24.4	-0.228539
2004	0.57749	663936718.2	1874033035	1421664.03	24.4	-0.158239
2005	0.68949	840490044.7	4982533943	1838389.93	22.2	0.163197
2006	0.56199	1189070582	4854416867	2290617.76	22.2	0.119838
2007	0.59164	1309572848	6034971231	3668657.82	22.6	0.100871
2008	0.63184	1631671650	8196606682	6920498.75	21.4	0.286968
2009	0.54282	1309207565	8554840766	9102049.11	23	-0.070073
2010	0.56338	1776187759	6048560269	2943635.852	23.4	-0.143139
2011	0.40633	1878614599	8841952784	4985091.858	22.6	-0.028561

***Sources**: C.B.N Statistical Bulletin and World Bank data.*

DATA FOR COMPUTATION OF SOLOW'S RESIDUAL

YEAR	CAPITAL(in billions)	LABOUR(% of population)	GDP
1996	2.4	56.4	35,299,150,000
1997	2.8	56.3	36,229,368,992
1998	3	56.2	32,143,818,182
1999	2.5	56	34,776,040,200
2000	3.3	55.8	45,983,449,593
2001	3.4	55.6	47,999,667,360
2002	4.2	55.3	59,116,868,249
2003	6.7	55	67,655,840,077
2004	6.5	54.6	87,845,403,966
2005	6.1	54.7	112,000,000,000
2006	12	54.9	145,000,000,000
2007	15	55	166,000,000,000
2008	17	55.2	207,000,000,000
2009	20	55.3	169,000,000,000
2010	27	55.5	229,000,000,000
2011	27	55.6	244,000,000,000

***Sources**: C.B.N Statistical Bulletin and World Bank data.*

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APPENDIX 2

UNIT ROOT TEST

Null Hypothesis: D(FDI2) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=1)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.125861	0.0003
Test critical values:	1% level	-4.004425	
	5% level	-3.098896	
	10% level	-2.690439	

*MacKinnon (1996) one-sided p-values.
Warning: Probabilities and critical values calculated for 20 observations

Augmented Dickey-Fuller Test Equation

Dependent Variable: D(FDI2,2)
Method: Least Squares
Date: 01/25/14 Time: 13:16
Sample (adjusted): 1998 2011
Included observations: 14 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(FDI2(-1))	-1.558655	0.254439	-6.125861	0.0001
C	-0.001259	0.002824	-0.445624	0.6638

R-squared	0.757704	Mean dependent var	0.001007
Adjusted R-squared	0.737513	S.D. dependent var	0.020450
S.E. of regression	0.010477	Akaike info criterion	-6.147660
Sum squared resid	0.001317	Schwarz criterion	-6.056366
Log likelihood	45.03362	Hannan-Quinn criter.	-6.156111

F-statistic	37.52617	Durbin-Watson stat	2.138256
Prob(F-statistic)	0.000051		

Null Hypothesis: D(EDU) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=1)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.113957	0.0082
Test critical values:	1% level	-4.004425	
	5% level	-3.098896	
	10% level	-2.690439	

*MacKinnon (1996) one-sided p-values.
Warning: Probabilities and critical values calculated for 20 observations
and may not be accurate for a sample size of 14

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(EDU,2)
Method: Least Squares
Date: 01/25/14 Time: 13:17
Sample (adjusted): 1998 2011
Included observations: 14 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(EDU(-1))	-1.162451	0.282563	-4.113957	0.0014
C	0.155111	0.057341	2.705077	0.0191

R-squared	0.585129	Mean dependent var	0.002034
Adjusted R-squared	0.550556	S.D. dependent var	0.243498
S.E. of regression	0.163243	Akaike info criterion	-0.655596
Sum squared resid	0.319778	Schwarz criterion	-0.564302
Log likelihood	6.589170	Hannan-Quinn criter.	-0.664047

F-statistic	16.92464	Durbin-Watson stat	1.825511
Prob(F-statistic)	0.001436		

Null Hypothesis: D(GOV2) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=1)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.578270	0.0000
Test critical values:	1% level	-3.588509	
	5% level	-2.929734	
	10% level	-2.603064	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(GOV2,2)
Method: Least Squares
Date: 01/25/14 Time: 13:20
Sample (adjusted):): 2006 2011
Included observations:6 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(GOV2(-1))	-1.014936	0.154286	-6.578270	0.0000
C	-0.059973	0.075154	-0.798010	0.4294

R-squared	0.507468	Mean dependent var	0.000000
Adjusted R-squared	0.495741	S.D. dependent var	0.696837
S.E. of regression	0.494832	Akaike info criterion	1.475193
Sum squared resid	10.28407	Schwarz criterion	1.556292
Log likelihood	-30.45424	Hannan-Quinn criter.	1.505268
F-statistic	43.27364	Durbin-Watson stat	2.146828
Prob(F-statistic)	0.000000		

Null Hypothesis: TRD2 has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=1)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.155507	0.0076
Test critical values:	1% level	-4.004425	
	5% level	-3.098896	
	10% level	-2.690439	

*MacKinnon (1996) one-sided p-values.
Warning: Probabilities and critical values calculated for 20 observations
and may not be accurate for a sample size of 14

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(TRD2)
Method: Least Squares
Date: 01/25/14 Time: 13:26
Sample (adjusted): 1998 2011
Included observations: 14 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
TRD2(-1)	-1.200902	0.288991	-4.155507	0.0016
D(TRD2(-1))	0.571946	0.220014	2.599594	0.0247
C	0.101299	0.030656	3.304350	0.0070

R-squared	0.611214	Mean dependent var	-0.002291
Adjusted R-squared	0.540526	S.D. dependent var	0.098477
S.E. of regression	0.066752	Akaike info criterion	-2.388245
Sum squared resid	0.049015	Schwarz criterion	-2.251304
Log likelihood	19.71771	Hannan-Quinn criter.	-2.400921
F-statistic	8.646612	Durbin-Watson stat	1.985571
Prob(F-statistic)	0.005539		

Null Hypothesis: D(T) has a unit root

Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=1)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.411848	0.0055
Test critical values:	1% level	-4.057910	
	5% level	-3.119910	
	10% level	-2.701103	

*MacKinnon (1996) one-sided p-values.
Warning: Probabilities and critical values calculated for 20 observations
and may not be accurate for a sample size of 13

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(T,2)
Method: Least Squares
Date: 01/25/14 Time: 13:33
Sample (adjusted): 1999 2011
Included observations: 13 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(T(-1))	-2.086460	0.472922	-4.411848	0.0013
D(T(-1),2)	0.503374	0.285858	1.760923	0.1087
C	0.078260	0.126903	0.616688	0.5512

R-squared	0.767530	Mean dependent var	0.046539
Adjusted R-squared	0.721036	S.D. dependent var	0.864418
S.E. of regression	0.456560	Akaike info criterion	1.468980
Sum squared resid	2.084469	Schwarz criterion	1.599353
Log likelihood	-6.548371	Hannan-Quinn criter.	1.442183
F-statistic	16.50817	Durbin-Watson stat	1.851906
Prob(F-statistic)	0.000679		

Null Hypothesis: CRP2 has a unit root

Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=1)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.036790	0.0087
Test critical values:	1% level	-3.959148	
	5% level	-3.081002	
	10% level	-2.681330	

*MacKinnon (1996) one-sided p-values.
Warning: Probabilities and critical values calculated for 20 observations
and may not be accurate for a sample size of 15

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(CRP2)
Method: Least Squares
Date: 01/25/14 Time: 13:39
Sample (adjusted): 1997 2011
Included observations: 15 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
CRP2(-1)	-1.101802	0.272940	-4.036790	0.0014
C	4.34E-07	1.79E-07	2.422052	0.0308

R-squared	0.556249	Mean dependent var	1.60E-08
Adjusted R-squared	0.522114	S.D. dependent var	8.19E-07
S.E. of regression	5.66E-07	Akaike info criterion	-25.80686
Sum squared resid	4.17E-12	Schwarz criterion	-25.71246
Log likelihood	195.5515	Hannan-Quinn criter.	-25.80787
F-statistic	16.29568	Durbin-Watson stat	2.049306
Prob(F-statistic)	0.001411		

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APPENDIX 3

REGRESSION OUTPUT

Dependent Variable: T
Method: Least Squares
Date: 01/25/14 Time: 12:47
Sample: 1996 2011
Included observations: 13

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-4.723934	1.555628	-3.036673	0.0039
EDU	0.327741	0.059681	5.491556	0.0000
FDI2	6.538516	5.441703	1.201557	0.2357
TRD_OPN	1.155376	0.565386	2.043516	0.0468
CRP01	-11.3855	83463.36	-1.364137	0.1792
GOV2	-0.097868	0.036628	-2.671957	0.0104

R-squared	0.817758	Mean dependent var	1.551141
Adjusted R-squared	0.800805	S.D. dependent var	14.28282
S.E. of regression	6.374607	Akaike info criterion	6.640854
Sum squared resid	1747.331	Schwarz criterion	6.835771
Log likelihood	-154.3805	Hannan-Quinn criter.	6.714514
F-statistic	48.23740	Durbin-Watson stat	2.719538
Prob(F-statistic)	0.000000		